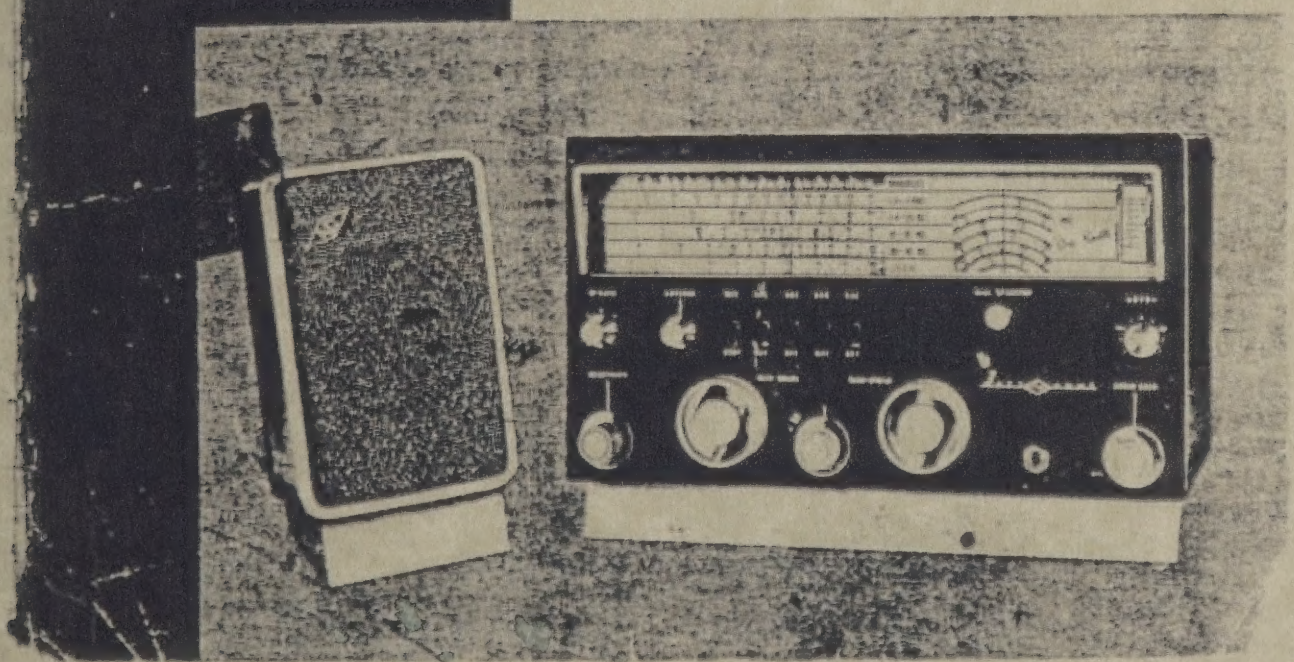
INSTRUCTION MANUAL

NC-190

National Radio Company, Inc.



READ CAREFULLY BEFORE TURNING ON YOUR NEW NC-190

The following instructions are designed to allow you to immediately set up your new NC-190 for proper operation using AM. SSB or CW receiving techniques. They are ONLY intended to provide a quick reference for proper set-up procedure. and we strongly recommend that you study the detailed instructions of this manual as soon as possible.

CW OPERATION

1. Set BANDSWITCH to desired band.
2. Set DIAL SELECTOR for desired calibration.
3. Set STBY-REC switch to REC.
4. The ANL switch is inoperative in this mode of operation and may be left in any setting.
5. Set AGC switch ON.
6. Set BFO switch ON.
7. Set CAL switch OFF.
8. Turn SELECTIVITY switch to 0.6 Kc.
9. Set BFO control to approximately 1 o'clock. BFO control may be moved from this setting as desired to obtain a comfortable beat note.
10. Turn RF GAIN control fully-clockwise.
11. Turn AF GAIN control clockwise to apply power to the receiver. Volume may then be adjusted with this control for a comfortable listening level.
12. Adjust ANTENNA control for maximum background noise in the absence of a signal.
13. Rotate BANDSPREAD control to set mark at the high frequency end of the scale.
14. The MAIN TUNING control is now properly calibrated and may be used to tune the receiver. The detailed instructions in the manual should be studied for proper setting of the MAIN TUNING control when it is desired to use the calibrated BANDSPREAD scales.

USE OF THE S METER

The S meter of the NC-190 receiver will indicate relative signal strength in all modes of operation. The AGC switch must be in the ON position for S meter operation. For proper signal strength indication. the RF GAIN control should be adjusted for a reading of approximately S1 in the absence of a signal.

BROADCAST BAND RECEPTION

For broadcast reception the MAIN TUNING control and the AUDIO GAIN control correspond to the TUNING and VOLUME controls of any broadcast receiver and may be so used providing the rest of the receiver controls are adjusted as indicated below:

1. Set BANDSWITCH to .54-1.6 Mc.
2. Set STBY-REC switch to REC.
3. Set ANL switch OFF.
4. Set AGC switch ON.
5. Set BFO switch OFF.
6. Set CAL switch OFF.
7. Turn SELECTIVITY switch to 5 Kc.
8. Turn RF GAIN to 3 o'clock.
9. Set BANDSPREAD tuning to set mark at high frequency end of scale.

AM OPERATION

1. Set BANDSWITCH to desired band.
2. Set DIAL SELECTOR for desired calibration.
3. Set STBY-REC switch to REC.
4. Set ANL switch ON or OFF as desired.
5. Set AGC switch ON.
6. Set BFO switch OFF.
7. Set CAL switch OFF.
8. Turn SELECTIVITY switch to 5 Kc or 3 Kc.
9. Turn RF GAIN control fully-clockwise.
10. Turn AF GAIN control clockwise to apply power to the receiver. Volume may then be adjusted with this control for a comfortable listening level.
11. Adjust ANTENNA control for maximum background noise in the absence of a signal.
12. Rotate BANDSPREAD control to set mark at the high frequency end of the scale.
13. The MAIN TUNING control is now properly calibrated and may be used to tune the receiver. The detailed instructions in the manual should be studied for proper setting of the MAIN TUNING control when it is desired to use the calibrated BANDSPREAD scales.

SSB OPERATION

1. Set BANDSWITCH to desired band.
2. Set DIAL SELECTOR for desired calibration.
3. Set STBY-REC switch to REC.
4. The ANL switch is inoperative in this mode of operation and may be left in any setting.
5. SET AGC switch ON.
6. Set BFO switch ON.
7. Set CAL switch OFF.
8. Turn SELECTIVITY switch to 3 Kc.
9. Set BFO control to the USB or LSB mark to select the desired sideband (usually LSB on the 80 and 40 meter amateur bands and USB on the 20, 15 and 10 meter amateur bands).
10. Turn RF GAIN control fully-clockwise.
11. Turn AF GAIN control clockwise to apply power to the receiver. Volume may then be adjusted with this control for a comfortable listening level.
12. Adjust ANTENNA control for maximum background noise in the absence of a signal.
13. Rotate BANDSPREAD control to set mark at the high frequency end of the scale.
14. The MAIN TUNING control is now properly calibrated and may be used to tune the receiver. The detailed instructions in the manual should be studied for proper setting of the MAIN TUNING control when it is desired to use the calibrated BANDSPREAD scales.

DESCRIPTION AND OPERATION

A world of adventure lies at your fingertips as you tune the NC-190 receiver. The chimes of Big Ben, the call of a Bell Bird in New Zealand. The news in English from foreign nations, the cryptic messages of police, aircraft, and ships at sea, the gossip and friendly talk of amateur radio operators around the world can all be heard in the comfort of your armchair. This world of short wave listening is available to you through proper use of the National NC-190.

Unlike regular broadcast stations that you hear any time of the day, short wave transmissions are subject to variation from day to day, time of day, season of the year and even such things as sunspot activity. These variations cause changes in the nature of the upper atmosphere of the earth, which acts like a giant mirror reflecting short wave radio signals. When conditions are right the radio signal may travel entirely around the world bouncing back and forth from the upper part of the atmosphere to the ground and back again. If the receiving antenna happens to be at one of the points of reflection then the signal may be heard as though it were located just next door.

Most of these variations follow definite patterns and as a result the short wave broadcasters schedule their times and frequencies of transmissions to take best advantage of transmitting conditions. Likewise the listener can take advantage of this information to achieve greatest satisfaction in pursuit of the hobby of short wave listening. In other words it is important to know where to look and when to listen.

A radio wave (like a wave in the ocean) goes through a repeated up and down motion. If this electrical signal varies up and down 100 times each second we say that its frequency is 100 cycles per sec. In the short wave spectrum tuned by the NC-190 this frequency may actually be measured as many millions of cycles, and it is therefore easier to divide the frequency by one million and call the result "megacycles". The dial of the NC-190 receiver is calibrated in "megacycles", an expression of the frequency of the radio signal to which we are tuned. Thus when a station is listed as transmitting on a frequency of 8.61 megacycles (8,610.000 cycles) it may be tuned by setting the NC-190 dials to this same frequency. A chart showing approximate frequency limits for various types of transmission covered by the NC-190 tuning range is given below. Many of these transmissions are in code or teletype, others are in voice, making up the myriad tones and voices of short wave radio.

Many short wave listeners find that their main interest is tuning the many foreign broadcast stations. It is always helpful to keep a log of the station heard and the date and time, as well as the frequency of reception. Most of these foreign broadcast stations welcome reports from listeners and mail out interesting and colorful cards confirming the fact that the station was heard and providing information about the country and the station. The collection of these cards is in itself an interesting hobby. Generally speaking, the foreign shortwave broadcast stations are found in groups or bands of frequency. The NC-190 bandspread dial is calibrated for six of these foreign broadcast bands as well as for five amateur bands. The shortwave broadcast listener will find the following chart useful as a guide to listening locations and times for best broadcast reception.

band	*frequency*	*Morning*	*Afternoon*	*Evening*
49 meters	5.9-6.3 mc.	good	poor	good
31 meters	8.6-10.0 mc.	poor	fair	good
25 meters	11.7-12.0 mc.	poor	fair	good
19 meters	14.6-15.4 mc.	fair	good	poor
16 meters	16.4-18.0 mc.	good	fair	poor
13 meters	21.5-22.0 mc.	good	fair	poor

These few words hardly scratch the surface of the hobby of short wave listening. For best results from the NC-190 receiver the following pages on operation of the receiver should be carefully studied. In addition the following publications should prove useful in furthering enjoyment of the hobby.

Official Log—National Association of Armchair Adventurers—National Radio Company, Melrose, Mass.

The Radio Amateur's Handbook and other publications American Radio Relay League, West Hartford, Conn.

How To Listen To The World

World Radio TV Handbook
Gilfer Associates, Box 239, New York 17, N. Y.

World Radio Handbook — World Radio Publications, 47 Mounthaven Dr., Livingston, N. J.

White's Radio Log — C. DeWitt White Co., P. O. Box 142, Bronxville, N. Y.

In addition many periodicals and the Government printing office publish information on a regular basis.

ALL FREQUENCIES IN MEGACYCLES

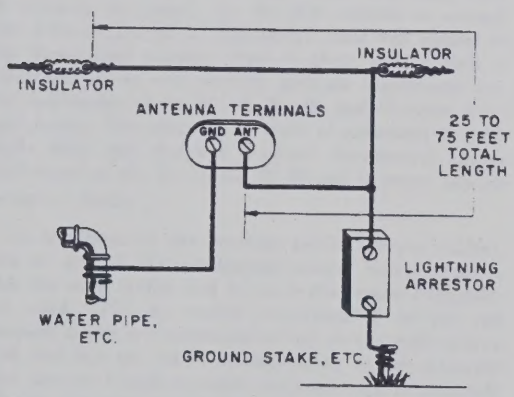
Amateur	International Broadcast	Frequency Standard (WWV)	Citizens Band	Marine	Aeronautical	Police	Public Safety (Forestry Conservat'n, State Guard, Special Emergency, Highway Maint.)	Industrial
1.8 - 2.0	2.3 - 2.5	2.5 MC	26.9 - 27.3 MC	2.0 - 2.8	2.6 - 3.5	1.6 - 1.8	2.2 - 2.3	1.6 - 1.8
3.5 - 4.0	3.2 - 3.4	5.0 MC		4.0 - 4.5	4.5 - 6.0	2.3 - 2.5	2.7 - 2.8	2.2 - 2.5
7.0 - 7.3	3.9 - 4.0	10.0 MC		6.2 - 6.6	6.5 - 7.0	2.8 - 2.9	3.2 - 3.3	4.6 - 4.7
14 - 14.4	4.7 - 5.1	15.0 MC	Common Carrier (Telephone, Telegraph, Press)	8.2 - 8.9	8.8 - 9.0	5.1 - 5.2	27.2 - 27.3	25.0 - 25.3
21 - 21.5	5.9 - 6.2	20.0 MC		12.3 - 13.2	10.0 - 11.5	7.4 - 8.0		27.2 - 27.5
28 - 29.7	7.1 - 7.3	25.0 MC	4.4 - 5.4	16.4 - 17.4	13.2 - 14.0		Broadcast Auxiliary (Remote Pick-up)	29.7 - 30.0
	9.5 - 9.8		6.7 - 8.0	22.0 - 22.8	15.8 - 18.0		1.6 - 1.7	
	11.7 - 12.0		9.0 - 9.5				25.8 - 26.5	
	15.1 - 15.5		9.7 - 11.7					
	17.7 - 17.9		13.3 - 21					
	21.4 - 21.8		22.6 - 24.6					
	25.6 - 26.1		29.8 - 30.0					

The National NC-190 receiver is designed to match an unbalanced 50 ohm antenna transmission line. Individual antenna coils are used on each band. Impedance match is obtained by use of small primary coupling windings on the antenna coils.

THE ANTENNA

The NC-190 incorporates two methods of antenna connection, a small coaxial jack for use when shielded types of lead-in are used, and a two terminal antenna strip suitably marked A (antenna) and G (ground) for use where individual lead wires are employed. The simplest antenna is a single long wire antenna illustrated in the figure below. When an antenna of this type is used, a suitable ground connection is recommended for best results. Generally speaking, an antenna between 15 feet and 40 feet long should provide ample signal pick-up for most of the bands in use. When the receiver is to be used predominantly on any one band, better results can be obtained with one of the many types of tuned antennas. The subject of antennas and the matching of antennas to receivers is in itself a major study. The owner of the NC-190 should consult many of the excellent references published by the American Radio Relay League and other organizations. In all cases where an external exposed antenna is employed, suitable consideration should be given to lightning protection for the sake of insuring safety to the operator and to the equipment.

The proper antenna coil is selected by means of the bandswitch which, switches the primary and secondary windings of the desired coil into the receiver circuit. On the broadcast band, the bandswitch connects the secondary of the antenna coil directly to the mixer grid bypassing the RF stage.



SINGLE WIRE ANTENNA

BANDSWITCH

The bandswitch of the NC-190 is labeled in megacycles. The switch is simply placed in the desired band position as indicated by the markings .54-1.6, 1.6-4.0, 4.0-10, 10-20 and 20-30. When the bandswitch has been set for the band desired, the corresponding general coverage dial scale is used to indicate the frequency of receiver tuning.

The secondary of the antenna coil is used as a tuned circuit to achieve selectivity in the antenna stage of the receiver. This coil is tuned by means of the main tuning capacitor, the bandspread capacitor and the antenna trimmer.

ANTENNA TRIMMER

The antenna trimmer control is used to make a final adjustment of the tuned circuit to insure maximum gain on the frequency region in use. Adjustment is necessary because the presence of various types of antennas will have some detuning effect on the antenna stage. The use of the antenna trimmer allows compensation of the receiver to match any type of antenna which may be connected to it. It is normally necessary to set the antenna trimmer only once for a frequency region in use. This is best accomplished by tuning the receiver away from any signal and adjusting the antenna trimmer for maximum background noise in the speaker or earphones.

The main tuning and bandspread capacitors determine the frequency to which the antenna, mixer and oscillator coils are tuned. The signal appearing across the antenna coil is coupled to the RF amplifier.

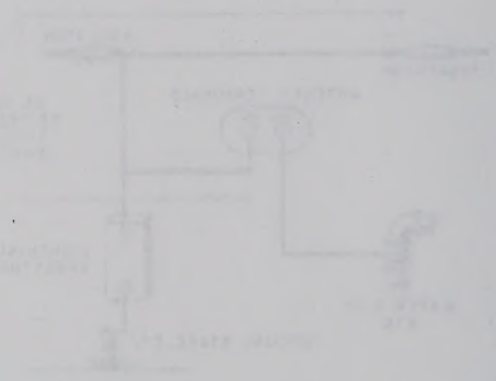
MAIN TUNING

The main tuning knob adjusts the setting of the main tuning capacitor. The pointer of the slide rule main tuning dial is coupled to the tuning capacitor to indicate frequency of operation. Proper frequency calibration of the main tuning dial depends on the setting of the bandspread dial. A triangular shaped set mark appears at the high frequency end of the bandspread scales in use. The bandspread dial should be set so that this triangular set mark appears directly under the bandspread index line. When set in this manner, the general coverage dial may be freely used to tune the receiver and the frequency of operation will be that determined by the dial scale corresponding to the setting of the bandswitch.

The bandspread capacitor is connected in parallel with the main tuning capacitor and acts as a vernier tuning control.

BANDSPREAD TUNING

The crowded frequency spectrum of the shortwave bands makes tuning of individual signals a difficult task unless some means of fine tuning (bandspread tuning) is provided. The bandspread knob of the NC-190 receiver provides this feature.



As the bandspread control is tuned counter-clockwise, the bandspread dial will rotate clockwise from the triangular set mark and the frequency to which the receiver is tuned will be reduced just as though the main tuning control were tuned to a lower frequency. Rotation of the bandspread control will accomplish this frequency change at a much slower rate than can be accomplished through use of the main tuning control, thus making it possible to tune the crowded shortwave bands with ease. The bandspread dial is calibrated in megacycles over regions of principal listener interest. Proper calibration of the bandspread dial ranges requires that the main tuning pointer be located at the triangular set mark corresponding to the bandspread range in use. If it is desired to use the bandspread dial as a fine tuning device, for frequencies at which it is not calibrated, the main tuning dial should be set just above the region of interest. The bandspread dial will now function as a fine tuning control in this frequency region even though it does not carry corresponding calibration marks.

The bandspread dial is attached to the bandspread capacitor by means of the exclusive National DIAL SELECTOR mechanism which permits mechanical change of the dial ranges appearing in the bandspread dial window.

DIAL SELECTOR

The exclusive National DIAL SELECTOR knob appears immediately below the bandspread dial window. It is operated by pulling the selector knob forward and rotating the knob one-half turn until the detent engages at which point the dial selector knob will snap back in towards the panel. As the dial selector is rotated, two different groups of bandspread dials will appear in the bandspread window. One of these sets of dials is calibrated in red and provides accurate bandspread tuning calibration of the 80, 40, 20, 15, and 10 meter amateur bands. The other set of dials is calibrated in midnight blue and provides accurate bandspread tuning calibration of the 49, 31, 25, 19, 16 and 13 meter foreign broadcast bands.

As mentioned in the previous section, proper calibration of any of the bandspread tuning ranges requires that the main tuning dial be set to the proper triangular set mark. The set marks corresponding to the red amateur scales are calibrated in red on the main tuning dial and the set marks corresponding to the midnight blue foreign broadcast scales are calibrated in midnight blue on the main tuning dial. The set marks are identified for each particular bandspread scale by the numbers appearing directly above them while the particular bandspread scale is identified by the same number appearing directly to the right of the bandspread index line when the triangular bandspread set mark is set at the index line. For example, the red set mark carrying the designation 80M corresponds to the 80 meter amateur band calibrated in red on the bandspread dial. When the main tuning pointer is set to this red mark and the bandswitch is set for the corresponding band, the bandspread dial will directly read frequencies between 3.5 and 4 megacycles, the frequency range of the 80 meter amateur band.

The signal from the RF stage is coupled to a primary winding on the mixer coil. The secondary of the mixer coil is tuned by another section of the main and bandspread tuning capacitors. The bandswitch again selects the proper coil corresponding to the band in use. The signal on the secondary of the mixer coil is coupled to the high frequency converter. The high frequency oscillator is a grounded plate Hartley oscillator using the cathode, grid and screen of the high frequency converter. A third section of the main and bandspread tuning capacitors tunes the oscillator with the bandswitch again selecting the coil for the band in use.

The high frequency oscillator operates 230 kilocycles above the signal on the two lowest frequency bands and operates 2215 kilocycles above the signal on the three highest frequency bands. The output of the converter is fed to two transformers, one at each of the above frequencies. Signals appearing across the secondary of these transformers are coupled to the second converter. A grounded plate Hartley oscillator is constructed between the cathode, grid and screen of this stage operating at a frequency of 1985 kilocycles. On the two lowest bands the bandswitch disables this oscillator and the second converter operates as a straight amplifier at 230 kilocycles. On the three highest bands, the oscillator is operating and converts the 2215 kilocycle signal to 230 kilocycles. The signal from the second converter is coupled to the patented National ferrite filter which provides excellent selectivity in the signal path and allows selection of overall bandwidth by means of the selectivity control.

SELECTIVITY

The selectivity switch of the NC-190 receiver provides for 3 degrees of selectivity. The selectivity switch is marked with positions for 5 Kc, 3 Kc and 0.6 Kc. The degree of selectivity used depends largely on the mode of operation desired and signal conditions. The 5 Kc position would normally correspond to the highest receiver fidelity. However, under conditions of extreme signal interference, it is often desirable to reduce the bandwidth of the receiver and sacrifice fidelity in favor of less interference through use of the 3 Kc position. In the event that CW reception is desired, even further bandwidth reduction is effective and useful and it is recommended that the 600 cycle position be used. In normal AM operation, the 3 Kc or 5 Kc bandwidth positions provide an adequate degree of selectivity. For CW operation, as stated before, the 600 cycle bandwidth is recommended and for single sideband operation, the 3 Kc bandwidth is recommended.

It should be noted that for AM reception, the beat frequency oscillator should be turned off. For single sideband or CW operation, the beat frequency oscillator should be turned on. The beat frequency oscillator is discussed in later sections of this book.

The signal from the ferrite filter is coupled to the first IF amplifier, then to the double tuned transformer between the first and second IF amplifier and appears on the second IF amplifier grid.

RF GAIN

The sensitivity of the receiver is adjusted by means of the RF gain control which controls the cathode bias on the RF and both IF stages. When the control is rotated to its maximum counter-clockwise position, the sensitivity of the receiver will be reduced to the point where no signal can be received. Rotating the control in the clockwise direction will increase sensitivity until maximum is reached at the full clockwise position. The RF gain control may be freely used as a means of sensitivity adjustment as the receiver is tuned from signal to signal or it may be set to a comfortable sensitivity level and allowed to remain in this position. Adjustment of the RF gain control will have some effect on the "S" meter reading. FOR PROPER INDICATION OF THE "S" METER it is recommended that the receiver be detuned from any signal and the RF gain control advanced until the background noise reaches a level sufficient to cause a reading of approximately 1 "S" unit on the "S" meter. This setting of the RF gain control should then suffice for all normal signal conditions.

The signal from the last IF stage is again coupled through a double tuned transformer which feeds the diode AM detector. The average signal level appearing at this detector is, at all times, proportional to signal input and is used as AGC voltage which is applied to the RF and first IF amplifiers and, in addition, to the mixer on the broadcast band only. A positive delay voltage is fed to the AGC bus and a separate diode in the 6T8 tube is used to prevent the AGC bus from actually going positive.

AGC SWITCH

The AGC switch is used to turn the automatic gain control on or off. Automatic gain control may be used in all modes of operation. When the AGC switch is turned on, the received signal level is automatically adjusted for a predetermined output and the "S" meter will indicate relative signal level. When the AGC switch is turned off, the "S" meter is disabled and the output of the receiver will vary in accordance with the incoming signal strength.

For single sideband or CW reception, the signal is coupled directly from the plate of the last IF amplifier to the triode product detector. A grounded cathode Hartley oscillator using the other triode of the product detector-BFO tube is used for BFO injection.

BFO SWITCH — BFO CONTROL

The BFO switch is used to turn the beat frequency oscillator on or off. When the BFO switch is turned off, the beat frequency oscillator is disabled and the BFO control will not function. When the BFO switch is turned on, the BFO control is used to adjust the frequency of the beat frequency oscillator which varies the pitch of the generated audio tone. When receiving single sideband signals, the beat frequency oscillator control should be set in the region marked USB or LSB depending on the desired sideband. It is not normally necessary to detune the beat oscillator from this setting. When receiving CW signals, a mid-position setting of the beat oscillator corresponds to a condition where maximum IF selectivity occurs at zero beat with the incoming signal and no audio tone will be observed at the point of maximum signal reception. It is therefore necessary to detune the beat oscillator control in either direction to provide a suitable audio tone which is comfortable to the operator and to obtain maximum amplitude of the desired beat note. During CW reception, it is often convenient to adjust the beat oscillator to phase an undesired signal to zero beat, thus eliminating it as an audible interfering signal.

The signal from the AM detector is coupled to a series gate automatic noise limiter which is designed to reject all signals exceeding the average modulation level.

ANL SWITCH

The ANL switch turns the automatic noise limiter on or off. The automatic noise limiter will function only when the BFO control is set in off position for AM reception. In normal operation, the noise limiter may be used at will depending on incoming noise level and operating convenience.

The signal from the product detector or the AM detector and noise limiter is coupled to the first audio amplifier through the audio frequency gain control. The setting of the BFO switch automatically connects the desired detector to the later circuits.

AUDIO GAIN

The audio gain control is used to adjust the speaker or earphone level to comfortable listening volume. It is important not to confuse the function of the audio gain control with the function of the RF gain control which controls the overall receiver sensitivity. Normally, with the RF gain control advanced to provide proper "S" meter reading, all additional variation of listening level is accomplished with the audio gain control. In the event of operation with AGC "OFF", the RF gain control is sometimes used as the master sensitivity control and the audio gain control is left set in a predetermined position. Proper balance between the two controls under this condition is normally a matter of individual operator preference and operating habits.

The amplified audio signal is coupled to the audio output stage and, in turn, through the audio transformer to the speaker terminals. The secondary winding of the audio transformer is designed to match a 3.2 ohm speaker such as the matching NTS-3 table speaker. The output signal is also coupled to a shorting type phone jack on the front panel.

PHONE JACK

The head phone jack is located on the front panel and will accept any normal 2 circuit phone plug. There is no DC voltage associated with the head phone circuit. Because of the low impedance of the audio transformer secondary almost any type of head phone may be used with completely satisfactory results. Insertion of a standard phone plug will break the loudspeaker circuit and silence the speaker.

The "S" meter is connected in a bridge circuit between the plate decoupling resistors of the first and second IF stages. AGC voltage is applied to the first of these stages so that the change in plate current will cause the "S" meter to read relative signal strength.

"S" METER

Normal adjustment of the "S" meter is readily accomplished by disconnecting the antenna and increasing the RF gain control to maximum sensitivity which corresponds to its extreme clockwise setting. The receiver should be tuned so that only background noise is heard and the antenna trimmer peaked. The "S" meter zero adjust control should then be adjusted to achieve a reading of approximately S1 on the incoming noise level. This will assure proper "S" meter reading. When properly adjusted, an "S" meter reading of S9 will correspond to approximately 50 microvolts of signal at the antenna terminals.

The power supply of the NC-190 receiver is a conventional transformer operated circuit using a full wave rectifier with suitable filter and shunt feed to the voltage regulator tube. The regulated voltage is used for all receiver oscillators to assure maximum stability. A standby-receive switch is used to remove power from plate and screen of most tubes for standby operation.

STBY-REC SWITCH

The Standby-Receive switch is a two position toggle switch which may be set to standby to mute the receiver or placed in the receive position for normal operation. An auxiliary pair of terminals on this switch is connected to the rear relay terminals in such a manner that the rear relay terminals are open circuited in the receive position and short-circuited in the Standby position. This allows control of an external relay circuit by means of the Standby-Receive switch. If the Standby-Receive switch is left in the Standby position, the receiver can be operated by shorting terminals 4 and 5 of the calibrator socket, thus providing for external control of the receiver.

A crystal calibrator socket is provided on the rear apron to accept the accessory XCU-109 crystal calibrator. The front panel calibrator switch is provided to turn the accessory calibrator on and off.

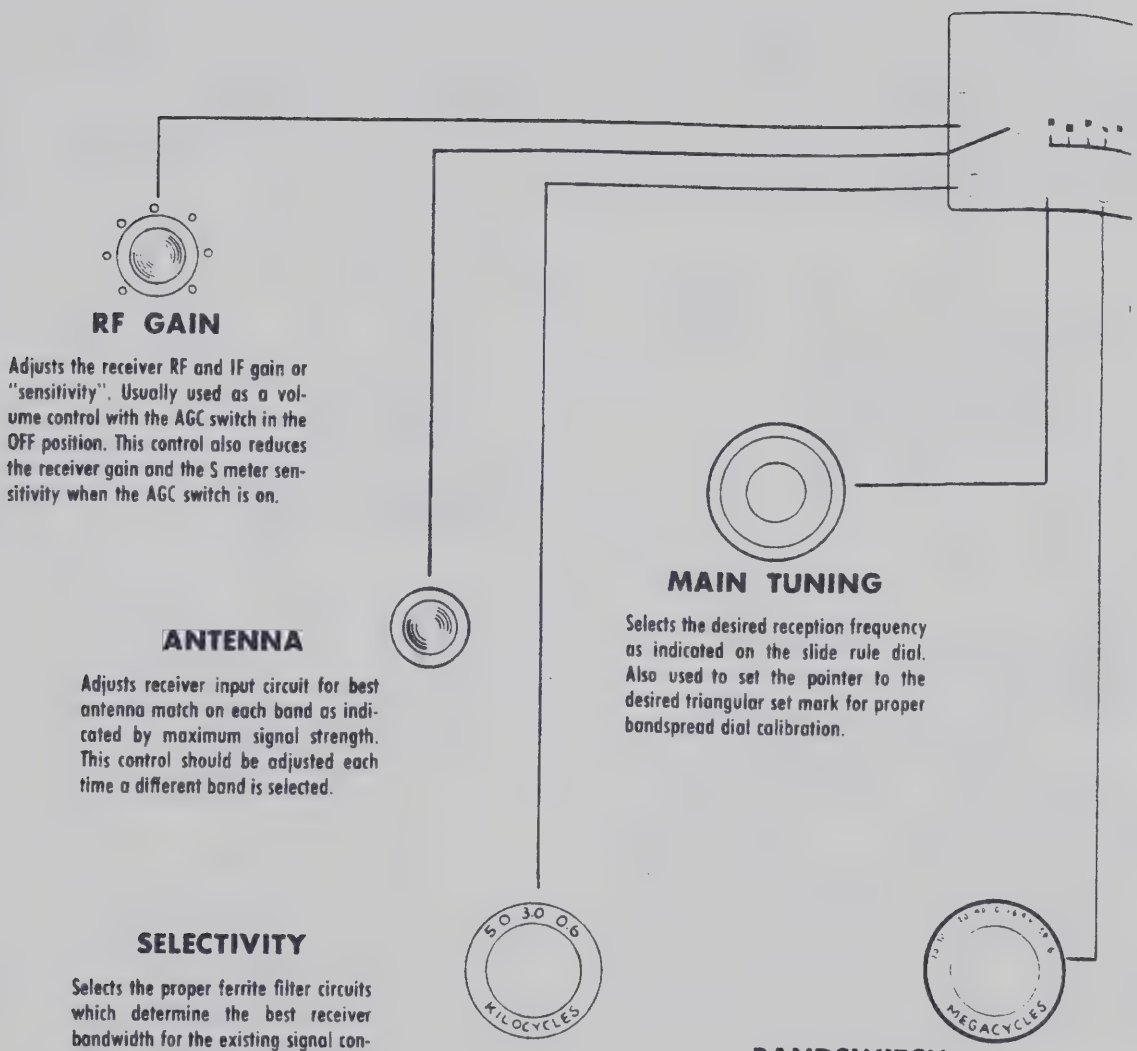
CRYSTAL CALIBRATOR

When the accessory XCU-109 calibrator is plugged into the receiver and the front panel calibrator switch is turned on, a signal will appear at every 1 megacycle point on the main tuning dial. As discussed in the sections on tuning, the main tuning dial will read correctly only when the bandspread dial is set to proper position. The 1 megacycle signals may now be used to check the accuracy of the main tuning dial. In the event that the 1 megacycle signal does not appear exactly at a 1 megacycle point on the dial, the bandspread dial may be slightly rotated to move the 1 megacycle signal to exact position on the main tuning dial. In like manner, the main tuning dial may be moved slightly from a set point to assure accurate calibration of the bandspread dial. It is sometimes convenient to turn on the beat frequency oscillator in order to add tone to the calibrator signal so that it may be more readily located.

A separate bottom cover and cabinet top are employed for ease in servicing and the National Radio Company patented Flip-Foot has been added for operator convenience.

CABINET

The Flip-Foot is easily elevated into the raised position or dropped back to the flat position for maximum operating ease. To elevate the Flip-Foot, lift the forward portion of the cabinet, reach under and pull the rear edge of the Flip-Foot down and forward until it reaches its upright position. To remove the top half of the cabinet it is necessary to remove the two screws on the lower forward corner of each side of the cabinet and the two screws at the lower outside corners of the back. Then remove the cabinet top by lifting and springing the front top lip of the cabinet free from the retaining clips attached to the panel. The cabinet is replaced by reversing this procedure, taking care to engage the slots in the forward lip of the cabinet into the two clips welded to the rear of the top section of the panel. The bottom cover of the receiver may be removed by removing the two rear mounting feet and by removing the four retaining screws. The bottom cover may then be slipped to the rear removing it from under the Flip-Foot, allowing free access to the wiring of the receiver.



RF GAIN

Adjusts the receiver RF and IF gain or "sensitivity". Usually used as a volume control with the AGC switch in the OFF position. This control also reduces the receiver gain and the S meter sensitivity when the AGC switch is on.

ANTENNA

Adjusts receiver input circuit for best antenna match on each band as indicated by maximum signal strength. This control should be adjusted each time a different band is selected.

MAIN TUNING

Selects the desired reception frequency as indicated on the slide rule dial. Also used to set the pointer to the desired triangular set mark for proper bandspread dial calibration.

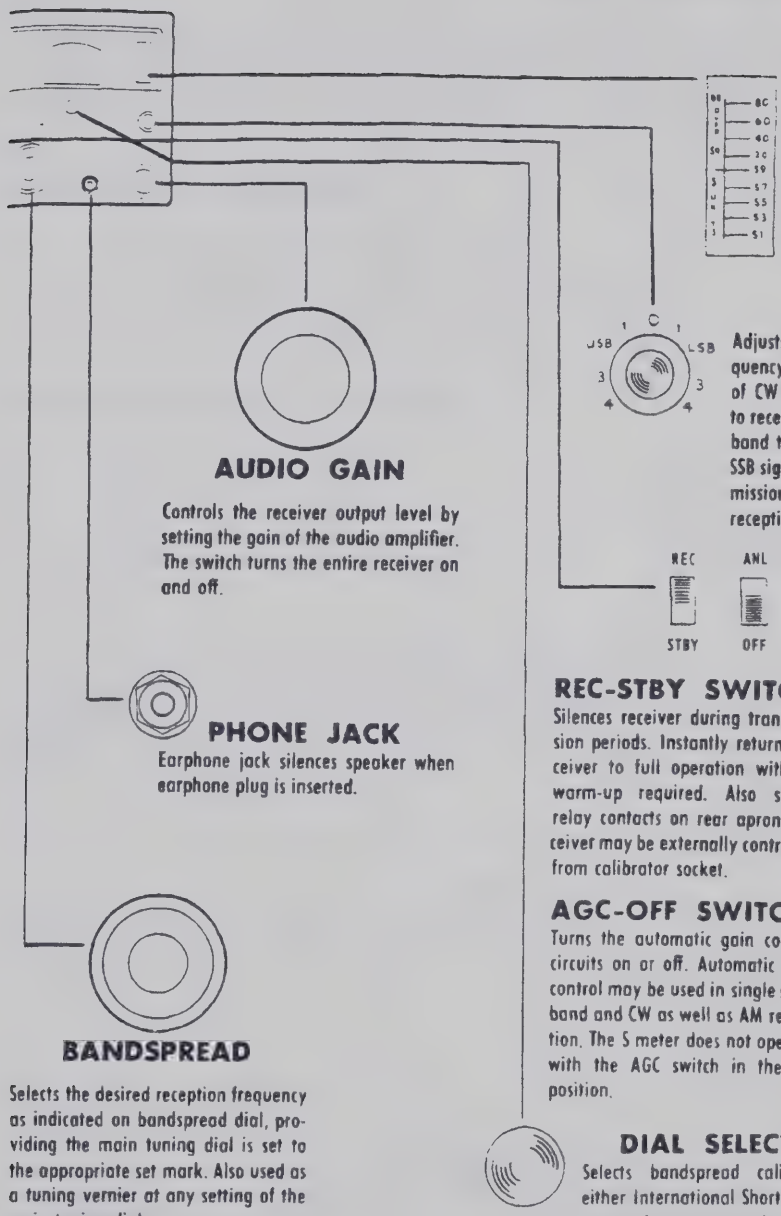
SELECTIVITY

Selects the proper ferrite filter circuits which determine the best receiver bandwidth for the existing signal conditions. The 0.6 Kc position is recommended for CW reception. The 5 Kc position is recommended for full fidelity AM reception. The 3 Kc position may be used for single sideband reception or AM reception under crowded band conditions.

BANDSWITCH

Selects the desired tuning range. The dial scale which corresponds to the selected range is used to indicate the receiver tuning range.

NC-190 CONTRO



S METER

Signal strength meter and tuning indicator. When RFG is fully clockwise an "S-9" reading is approximately equivalent to a 50 μV input at the antenna terminals. The S meter operates whenever the AGC switch is turned on.

BFO

Adjusts the tuning of the beat frequency oscillator to control the pitch of CW signals. Set the pointer to USB to receive SSB signals using upper sideband transmission and LSB to receive SSB signals using lower sideband transmission. Should be offset for CW reception.

AUDIO GAIN

Controls the receiver output level by setting the gain of the audio amplifier. The switch turns the entire receiver on and off.

PHONE JACK

Earphone jack silences speaker when earphone plug is inserted.

BANDSPREAD

Selects the desired reception frequency as indicated on bandspread dial, providing the main tuning dial is set to the appropriate set mark. Also used as a tuning vernier at any setting of the main tuning dial.

REC-STBY SWITCH

Silences receiver during transmission periods. Instantly returns receiver to full operation with no warm-up required. Also shorts relay contacts on rear apron. Receiver may be externally controlled from calibrator socket.

AGC-OFF SWITCH

Turns the automatic gain control circuits on or off. Automatic gain control may be used in single sideband and CW as well as AM reception. The S meter does not operate with the AGC switch in the off position.

ANL-OFF SWITCH

Turns the automatic noise limiter on or off to minimize impulse type noise.

BFO-OFF

Turns the Beat Frequency oscillator on and selects the triode product detector for single sideband and CW operation. In the OFF position, the diode detector is used.

CAL-OFF

Turns on the separate calibration oscillator to provide strong accurate marker frequencies every 1 megacycle throughout the entire tuning range.

DIAL SELECTOR

Selects bandspread calibration for either International Shortwave Broadcast or Amateur reception. To change the calibration pull the knob out and rotate one-half turn until the detent engages.

L DESCRIPTIONS

ALIGNMENT INSTRUCTIONS

The NC-190 receiver has been carefully aligned at the factory by specially trained and experienced personnel using precision equipment. Alignment of the receiver should not be attempted until all other possible causes of faulty operation have been investigated. Alignment should be made only by persons familiar with communications receivers and experienced in their alignment. Refer to figure 3 for location of all alignment adjustments.

EQUIPMENT REQUIRED

1. Signal generator covering 200 Kc to 35 Mc.
2. Vacuum tube voltmeter (VTVM)
3. Output meter. The AC scale of the VTVM can be used.
4. Tuning Wand — General Cement No. 8278 or equivalent.
5. Hex alignment — General Cement No. 5097 or equivalent.

INITIAL CONTROL SETTINGS

STBY-REC ..... Receive
ANL ..... Off
AGC ..... Off
BFO ..... Off
Bandswitch ..... As indicated in chart.
RF and AF Gain ..... Fully Clockwise

Selectivity ..... 0.6 Kc
Antenna ..... Mid-Range
Calibrator ..... Off
Bandspread ..... At "Set" point.
Main Tuning ..... At minimum capacity.
Dial Selector ..... Amateur Bandspread.

230 KC IF ALIGNMENT

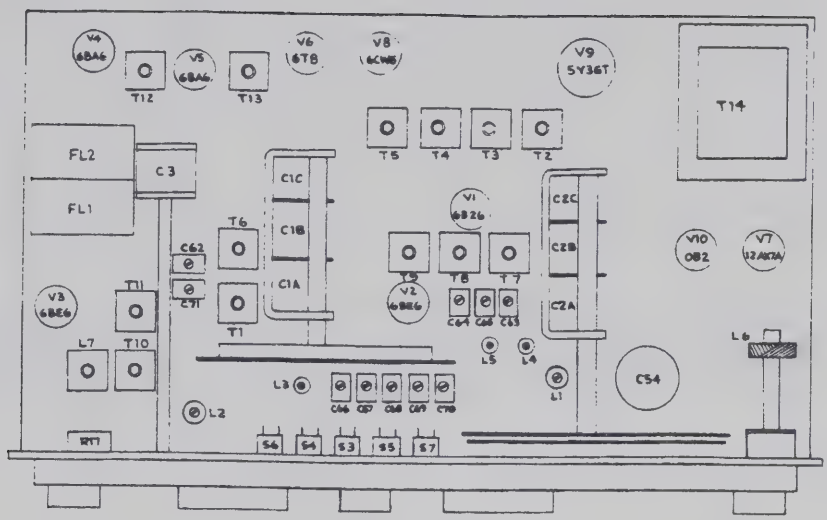
Signal Generator Connections	Signal Generator Frequency	Bandswitch Setting	Output Connections	Remarks
High side directly to mixer section of tuning gang. Low side to chassis.	230 Kc (unmod.)	Broadcast Band	VTVM DC probe to junction of R23 and C43. Low side to chassis.	Adjust FL1, FL2 for maximum indication. Rock generator to insure cores tune through maximum. Peak both sides of T11, T12 and T13. Maintain approximately 2V reading on VTVM.

BFO ALIGNMENT

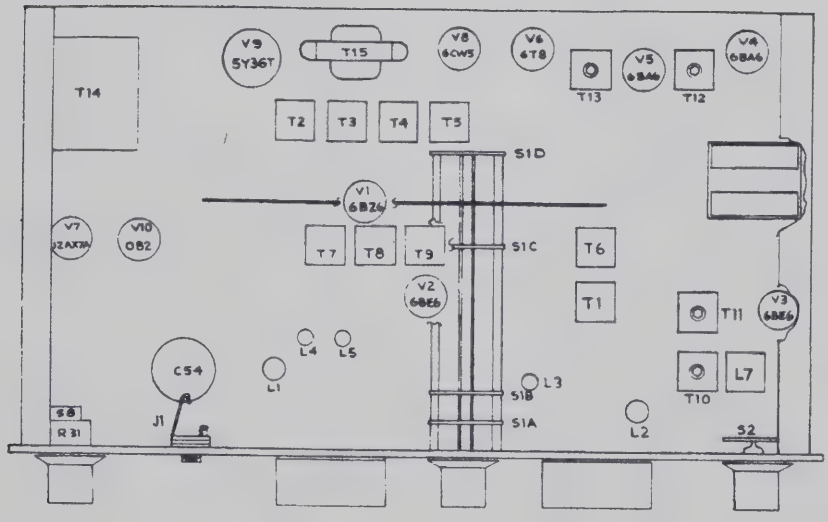
High side directly to mixer section of tuning gang. Low side to chassis.	230 Kc (unmod.)	Broadcast Band	VTVM DC probe to junction of R23 and C43. Low side to chassis.	Rock generator for maximum output. Maintain approximately 2V reading on VTVM. Set BFO switch on. Set BFO knob to center mark on panel. Loosen BFO knob set screw and adjust L8 to zero beat with screwdriver through hole in shield. Then tighten set screw and return BFO switch to Off position.

2215 KC IF ALIGNMENT

High side directly to mixer section of tuning gang. Low side to chassis.	2215 Kc (unmod.)	4-10 MC	VTVM DC probe to junction of R23 and C43. Low side to chassis.	Set generator frequency to 2215 Kc. Set L7 for maximum output. The second peak from the bottom of the coil should produce the correct oscillator frequency of 1985 Kc. Peak top and bottom of T10. Maintain approximately 2V reading on VTVM.



TOP VIEW



BOTTOM VIEW

ALIGNMENT LOCATIONS

RF ALIGNMENT

Before proceeding with RF Alignment, check dial pointer for proper indexing. With tuning gang fully closed, set the pointer so that it reads exactly "0" on the logging scale. With bandspread capacitor fully closed, adjust dial disc to the exact low frequency end of the calibrated scales. Then open bandspread capacitor to "Set" mark.

Output Meter Connections — VTVM DC probe to junction of R23 and C43. Low side to chassis. Maintain approximately 2V reading on VTVM.

Signal Generator Connections — Connect high side of generator to "Ant." terminal through a 68 Ω. ½W resistor. Low side to "Gnd" terminal.

Control Settings — Adjust generator for 30% modulation. Set selectivity control for 3.0 Kc. and all other controls at their initial settings given previously.

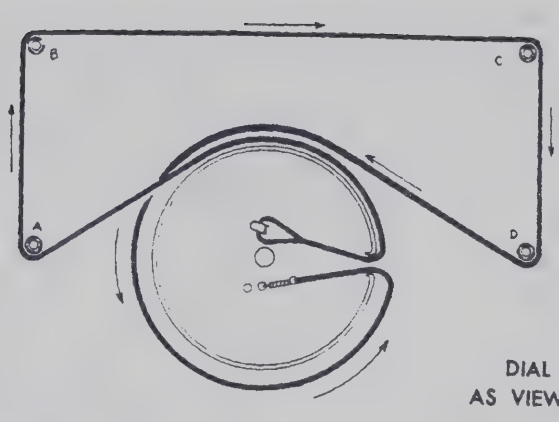
General Instructions — The oscillator circuits should always be adjusted first for proper dial calibration at the specified frequencies on each band. Then the mixer and RF circuits should be set for maximum output. A certain amount of interaction may occur between oscillator and RF adjustments. Final adjustment should be made for correct calibration. The trimmer adjustments should always be the final adjustment for each band. The oscillator frequency is always on the high side of the signal frequency. Suitable precautions or checks should be used to insure this condition.

Bandswitch Setting	Generator and Receiver Frequency	Adjustments
.54-1.6 MC (Broadcast)	.6 MC	L1 for correct calibration T1 for maximum output
	1.5 MC	C66 for correct calibration C71 for maximum output
1.6-4.0 MC	1.8 MC	L2 for correct calibration T6, T2 for maximum output
	4.0 MC	C67 for correct calibration C62, Ant. Trim. for maximum output
4.0-10 MC	4.0 MC	L3, for correct calibration T7, T3 for maximum output
	10.0 MC	C68, for correct calibration C63, Ant. Trim. for maximum output
10-20 MC	11.0 MC	L4 for correct calibration T8, T4 for maximum output
	20.0 MC	C69 for correct calibration C64, Ant. Trim. for maximum output
20-30 MC	20.0 MC	L5 for correct calibration T9, T5 for maximum output
	30.0 MC	C70 for correct calibration C65, Ant. Trim. for maximum output

PARTS LIST

ALL READILY AVAILABLE RESISTORS AND CAPACITORS ARE OMITTED FROM THE FOLLOWING PARTS LIST, BUT ARE COMPLETELY IDENTIFIED ON THE SCHEMATIC.

A-11998	Jack Phono. ANT	J1
A-11153	Plug Phono. ANT	P1
A-12616	Panel Terminal (Relay)	
A-12617	Panel Terminal (Speaker)	
E-265-28	Panel Terminal (Antenna)	
B-27669-3	Socket. 7 Pin	
B-27668-1	Socket. 9 Pin	
B-27674-1	Socket. Octal	
B-22025-3	Transformer. Output	T15
C-50087	Transformer. Power	T14
C-19458-5	Capacitor Electrolytic	C54
A-50137	Capacitor Mica Trimmer— 1.5-20 μμf C62 through	C71
A-50408	Pulley Bracket. Dial Cord	
A-20165-2	Pulley. Dial Cord	
C-50415-2	Main Tuning Capacitor	C1
A-50448	Disc Drive. Main Tuning	
C-50423	Bandspread Tuning Capacitor	C2
A-50501	Bracket. Light	
B-50466	Potentiometer S-Meter	R20
B-50089	Potentiometer AF-Gain	R31
B-50431	Switch Selectivity	S2
B-50092	Potentiometer RF-Gain	R17
A-50263	Phone Jack	J2
C-50412	RF Shield	
C-50414	Switch. Band	S1
B-50095-2	Variable Capacitor. Antenna	C3
B-50259	Ferrite Filter. Complete	FL1, FL2
A-50455	Shield Cover. Ferrite Filter	
B-50103	Transformer IF. 230 Kc	T11, T12, T13
B-50510	Transformer 2215 KC	T10
B-50429	Coil Antenna—1.6-4 Mc	T2
B-50452	Coil Antenna—4-10 Mc	T3
B-50451	Coil Antenna—10-20 Mc	T4
B-50460	Coil Antenna—20-30 Mc	T5
B-50443	Coil. 2nd Oscillator	L7
B-50430	Transformer Mixer—500-1600 Kc	T1
B-50432	Transformer Mixer—1.6-4 Mc	T6
B-50447	Transformer Mixer—4-10 Mc	T7
B-50453	Transformer Mixer—10-20 Mc	T8
B-50459	Transformer Mixer—20-30 Mc	T9
A-19405	Mounting Clips. Coil Cans	
B-50463	Coil Oscillator—500-1600 Kc	L1
B-50464	Coil Oscillator—1.6-4 Mc	L2
B-50465	Coil Oscillator—4-10 Mc	L3
B-50467	Coil Oscillator—10-20 Mc	L4
B-50469	Coil Oscillator—20-30 Mc	L5
B-17436-9	330 Ohms. 7 Watt Resistor	R37
K-098-24	2.2 Ohms. 1 Watt Resistor	R39
NCS-15-221-G-5	220 ±2% Mica Capacitor	C4, C10
NCS-15-331-G-5	330 ±2% Mica Capacitor	C5, C11
NCS-15-991-G-5	990 2% Mica Capacitor	C14
NCS-19-252-G-5	2500 2% Mica Capacitor	C15
NCS-15-821-G-5	820 2% Mica Capacitor	C16
NCS-15-351-G-5	350 2% Mica Capacitor	C17
NCS-15-181-G-5	180 2% Mica Capacitor	C18
NCS-20-392-F-5	3900 ±1% Mica Capacitor	C25, C26
B-50473-1	Line Cord	
D-50436-3	Front Panel	
A-50148-52	Hose Clamp. BFO	
B-50188-4	Iron Core. BFO	
B-50470	Coil BFO	
A-50421	Spring Slug Screw. BFO	
B-K641-20	Coil Shield. with Fasteners. BFO	
C-50437-3	Window. Main tuning	
B-50417-1	Bandspread Dial Ass'y.	
A-50439	Spring. Bandspread	
B-50416-1	Assembly—Female Detent. Bandspread	
A-50502	Disc Drive. Bandspread	
A-50284-4	Push-on Nut. Bandspread Drive	
C-50438-4	Dial Back Plate	
B-50110-2	Pointer Rail	
C-50441-1	S Meter	
C-50441-2	Clip Mounting. S Meter	
B-50424	Pointer	
B-19347-6	Dial Cord Ass'y.	
A-50118-1	Bushing Panel. Main tuning	
A-50117-1	Bushing Nut. Main tuning	
B-50536	Bandspread Vernier with Pinch	
A-50117-3	Nut. Bandspread Vernier	
A-50282	Bowed "E" Ring. Bandspread Vernier	
D-22500-X38-X-4AA	Knob Band	
B-50132	Bezel Front Panel	
B-50518-2	Knob. BFO with Set Screw	
B-50519-2	Knob. RFG. ANT with Set Screw	
B-50499	Knob Bandspread Chg.	
D-22500-X38-X-4T	Knob AFG	
D-22500-X38-X-4Z	Knob Selectivity	
C-22034-48	Knob Main Tuning	
	Knob. Bandspread	
NPL-47	Panel Lamp	
6BZ6	6BZ6 Tube	V1
6BE6	6BE6 Tube	V2, V3
6BA6	6BA6 Tube	V4, V5
6CW5	6CW5 Tube	V8
12AX7A	12AX7A Tube	V7
5Y3-GT	5Y3-GT Tube	V9
B-50300	Panel Lamp Socket Ass'y.	
6T8	6T8 Tube	V6
0B2	0B2 Tube	V10
B-50145-2	Flip Foot	
SR-125-B-14-N	Rivets. Flip foot	
A-50284-3	Push-On Tinnerman. Flip foot	
A-50280	Glide	
A-50281-2	Rubber Foot	
D-50462-2	Bottom Cover Painted	
D-50418-5	Cabinet Ass'y.	
B-50434	Switch Bracket	
B-50457-1	Switch. CAL	
B-50457-3	Switch. ANL	
B-50457-11	Switch. AGC. BFO and STBY-REC	
A-50284-2	Push-On Nut, Switch Bracket	



DIAL CORD INSTALLATION
AS VIEWED FROM REAR OF SET
WITH
TUNING CAPACITOR AT
MAXIMUM MESH

DIAL CORD ASSEMBLY

STANDARD FORM WARRANTY
of
NATIONAL RADIO COMPANY, INC.
A Wholly owned subsidiary of NATIONAL COMPANY, INC.

This equipment is warranted to be free from defective material and workmanship and repair or replacement will be made of any part which under normal installation, use and service discloses defect, provided the unit is delivered by the owner to the manufacturer or through the authorized radio dealer or wholesaler from whom purchased, intact, for examination, with all transportation charges prepaid to the factory, within ninety days from the date of sale to original purchaser, and provided that such examination discloses in the manufacturer's judgment that it is thus defective.

Damages arising out of the breach of warranty to the owner shall be limited to the return of the goods and repayment of the purchase price or to the repair or replacement of non-conforming goods or parts at the election of the manufacturer.

This warranty does not extend to any radio products which have been subjected to misuse, neglect, accident, incorrect wiring, improper installation, or to use in violation of instructions furnished by the manufacturer, nor does it extend to units which have been repaired or altered outside of the factory, nor to cases where the serial number thereof has been removed, defaced or changed, nor to accessories used therewith of other manufacture.

Any part of a unit approved for remedy or exchange hereunder will be remedied or exchanged by the authorized radio dealer or wholesaler without charge to the owner.

This warranty is in lieu of all other warranties expressed or implied and no representative or person is authorized to assume for the manufacturer any other liability in connection with the sale of their radio products.

National Radio Company, Inc. reserves the right to make any change in design or to make addition to, or improvements in, its products without imposing any obligations upon itself to install them in its products previously manufactured.

NATIONAL RADIO COMPANY, INC.
Melrose 76, Mass.

NC-190 SPECIFICATIONS

The NC-190 is a 10 tube general coverage communications receiver featuring double conversion, variable IF Selectivity, and CALIBRATED INTERNATIONAL BROADCAST and AMATEUR bandspread, made possible by National's exclusive Dial Selector.

MAIN TUNING RANGES	INTERNATIONAL BROADCAST BANDSPREAD	AMATEUR BANDSPREAD
540 - 1600 KC	13 Meter Band (21.5 - 22.1 MC)	10 Meters (26.6 - 30.0 MC)
1.6 - 4.0 MC	16 Meter Band (16.4 - 18.0 MC)	15 Meters (21.0 - 21.5 MC)
4.0 - 10.0 MC	19 Meter Band (14.6 - 15.4 MC)	20 Meters (13.8 - 14.5 MC)
10.0 - 20.0 MC	25 Meter Band (11.7 - 12.0 MC)	40 Meters (6.9 - 7.5 MC)
20.0 - 30.0 MC	31 Meter Band (8.6 - 10.0 MC)	80 Meters (3.5 - 4.0 MC)
	49 Meter Band (5.9 - 6.3 MC)	

IMAGE REJECTION: Double conversion on all bands above 4 MC practically eliminates unwanted images. 1st IF—2215 Kc. 2nd IF—230 Kc.

SENSITIVITY: Better than 1 microvolt for a 10db signal to noise ratio.

STABILITY: Highest quality components, ceramic coil forms, voltage regulation. ⅛" panel and solid chassis provide excellent thermal and mechanical stability.

SELECTIVITY: National's exclusive "Ferrite Filter" provides 600 cycle bandwidth for CW, 3 KC for SSB and a full 5 KC for AM reception.

AUTOMATIC GAIN CONTROL (AGC): Full AGC for SSB, CW and AM reception.

"S" METER: Operates on all modes of reception including SSB and CW. Calibrated in 9 "S" units and in decibles above S-9.

NOISE LIMITERS: High performance automatic series gate noise limiter for AM reception. IF limiting for SSB and CW reception.

RF CIRCUITS: Two highly selective tuned circuits couple signals to the low noise 6BZ6 RF stage and the 6BE6 mixer. An antenna trimmer is included so that any antenna may be used.

TUBE COMPLEMENT:
6BZ6—RF Amplifier
6BE6—HF Converter
6BE6—2nd Converter
6BA6—IF Amplifier
6BA6—IF Amplifier
12AX7A—Product Det—BFO
6T8—AM Det. ANL. AGC. Audio Amp
6CW5—Audio Output
5Y3GT—Pwr Rect
0B2—Voltage Reg

IF AMPLIFIER: Two high gain IF amplifier stages are used to provide maximum reserve gain.

PRODUCT DETECTOR: A true triode product detector with an exceptionally stable BFO provides clear, undistorted SSB and CW reception.

AM DETECTOR: A separate, well proven diode detector is used for regular AM reception.

TUNING RATIO: Built-in National vernier provides an unusually high tuning ratio of 60/1 on all bandspread ranges, making AM, CW, and SSB tuning remarkably easy. Main Tuning ratio is 12/1.

AUDIO AMPLIFIER: The audio amplifier is capable of producing more than a full watt of high quality, full frequency range audio output at the 3.2 ohm speaker terminals. A front panel earphone jack is also provided.

CALIBRATOR: An accessory calibrator unit produces strong, accurate 1MC marker signals through the entire tuning range.

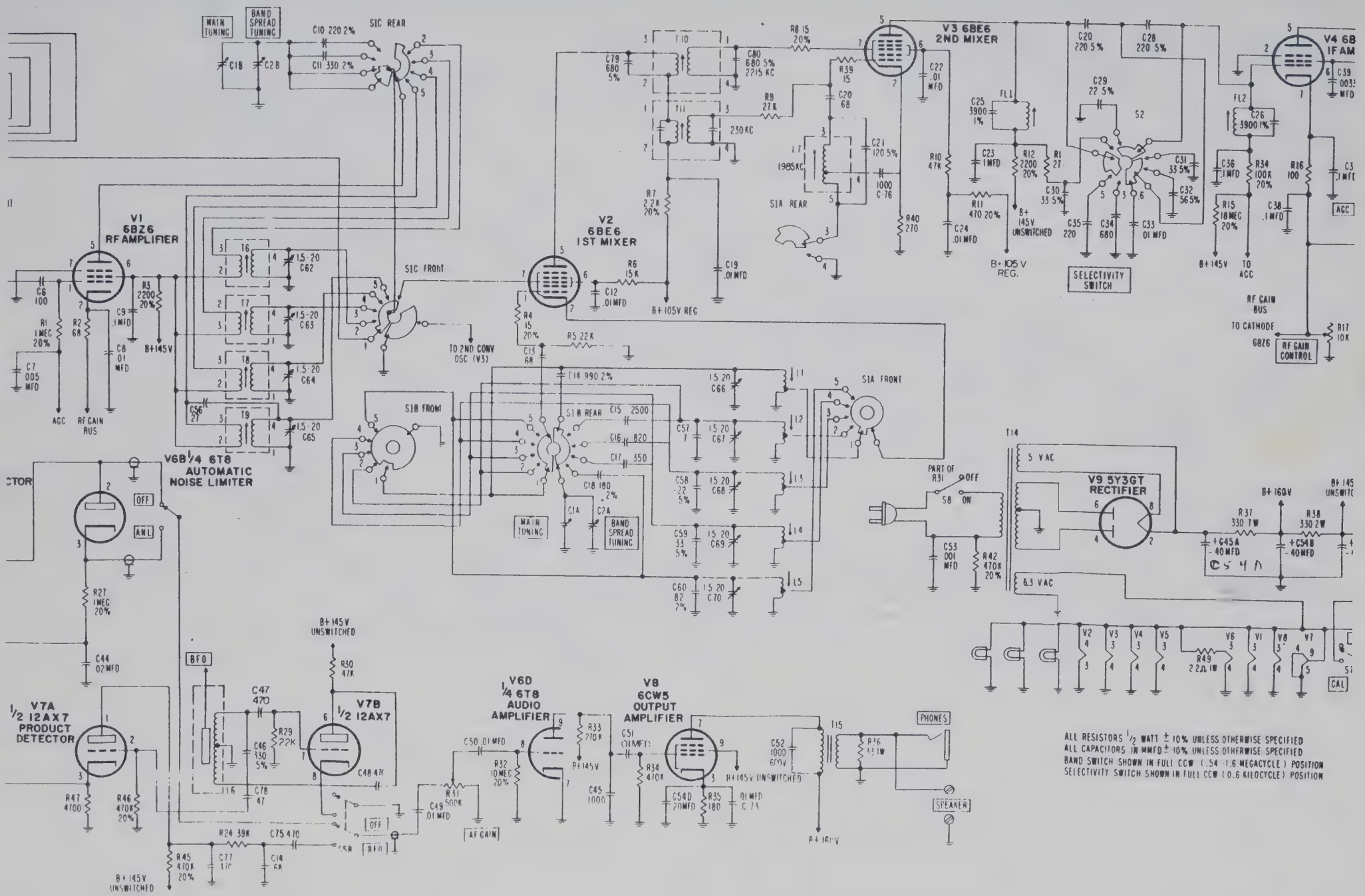
CONTROL CIRCUITS: The NC-190 may be externally controlled by shorting two terminals of the "Calibrator" socket with the "STBY-REC" Switch in the "Standby" position. The Relay terminals on the rear of the set are shorted by the "STBY-REC" switch in the STBY position.

FLIP FOOT: Unique "Flip Foot" on receiver and matching speaker for maximum operating convenience.

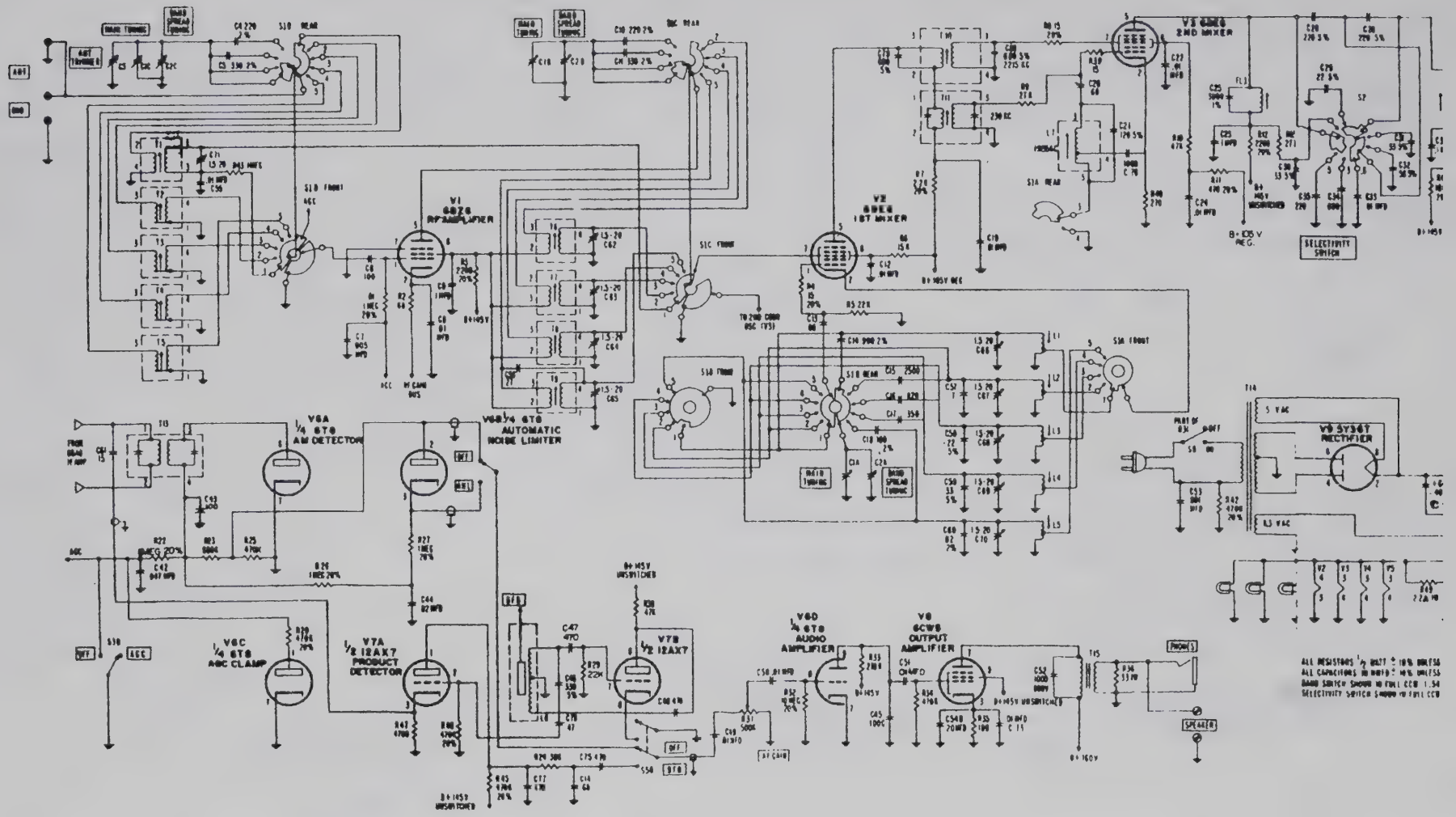
POWER REQUIREMENTS: 105-125 volts AC, 50-60 cycles. Power consumption 75 watts.

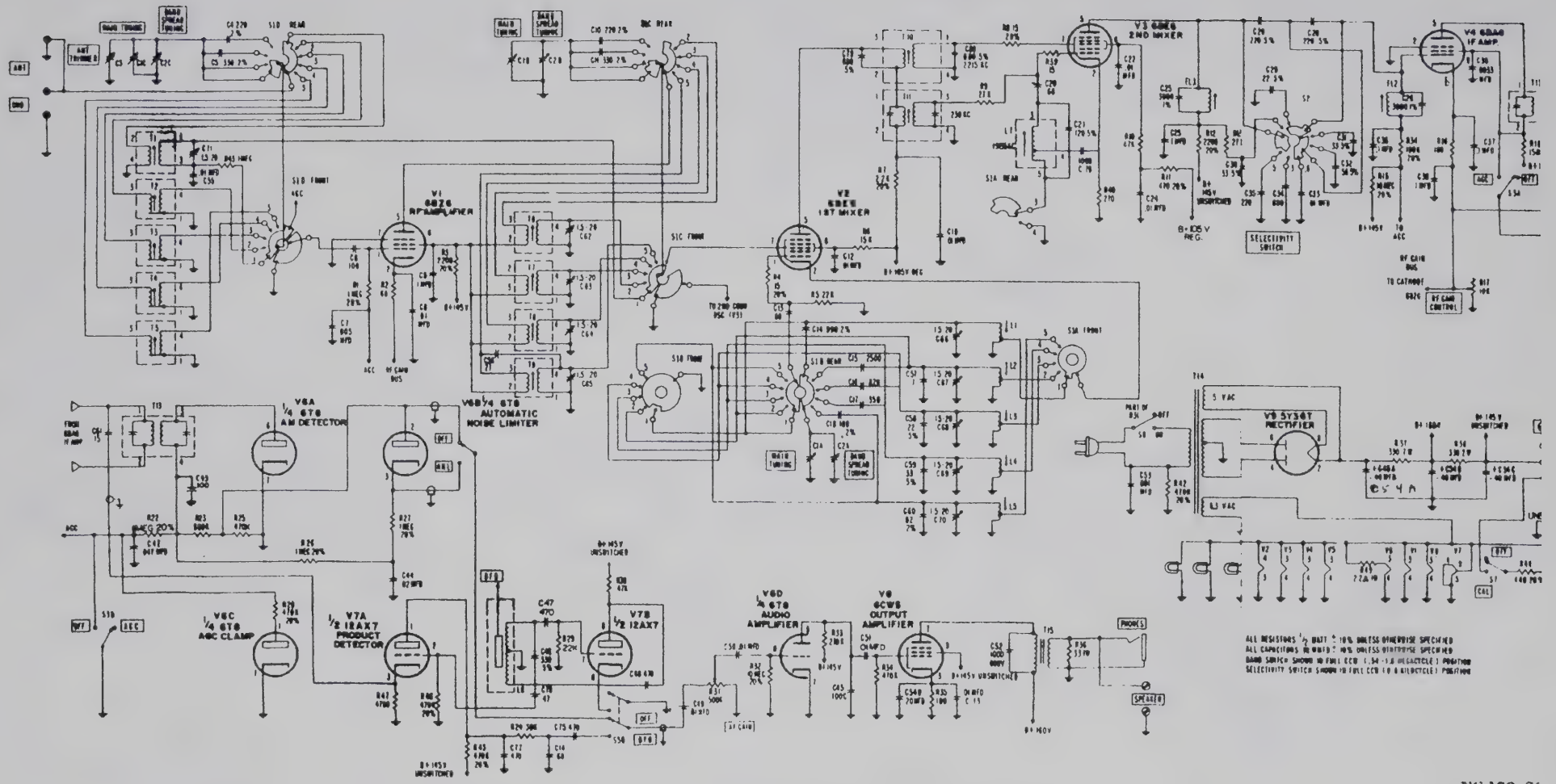
DIMENSIONS: 8¾" high; 15¾" wide; 9" deep.

SHIPPING WEIGHT: 28 lbs.

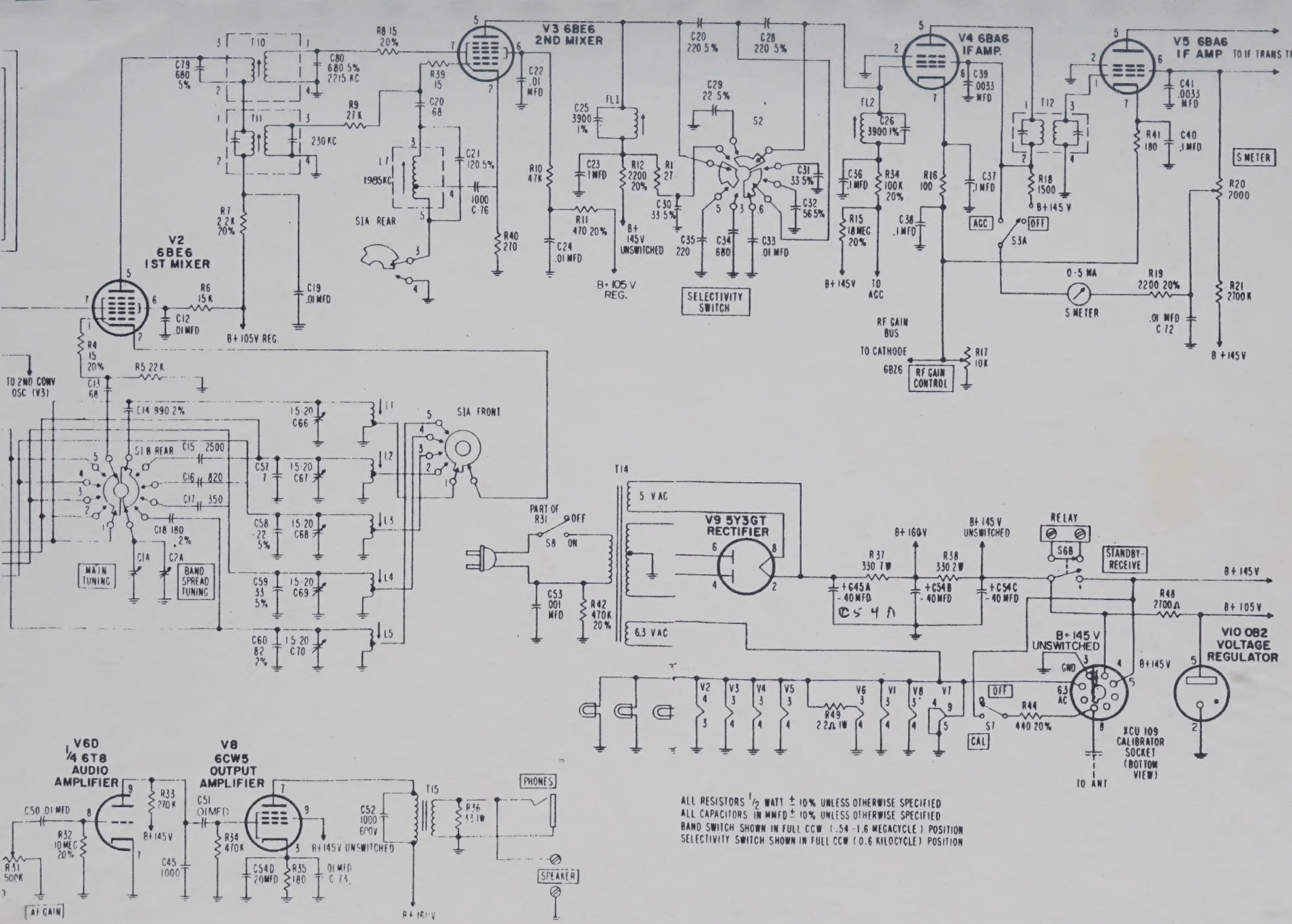

V1 6BZ6 RF AMPLIFIER
V2 6BE6 1ST MIXER
V3 6BE6 2ND MIXER
V4 6BA6 IF AMP
V6B 1/4 6T8 AUTOMATIC NOISE LIMITER
V6D 1/4 6T8 AUDIO AMPLIFIER
V7A 1/2 12AX7 PRODUCT DETECTOR
V7B 1/2 12AX7
V8 6CW5 OUTPUT AMPLIFIER
V9 5Y3GT RECTIFIER
MAIN TUNING
BAND SPREAD TUNING
S1C REAR
S1C FRONT
S1B REAR
S1B FRONT
S1A REAR
S1A FRONT
S2
SELECTIVITY SWITCH
RF GAIN CONTROL
RF GAIN BUS
AGC
ANL
BFO
CAL
PHONES
SPEAKER
B+145V UNSWITCHED
B+105V REG
B+160V
TO 2ND CONV OSC (V3)
TO CATHODE 6BZ6
ALL RESISTORS 1/2 WATT ± 10% UNLESS OTHERWISE SPECIFIED
ALL CAPACITORS IN MMFD ± 10% UNLESS OTHERWISE SPECIFIED
BAND SWITCH SHOWN IN FULL CCW (.54-1.6 MEGACYCLE) POSITION
SELECTIVITY SWITCH SHOWN IN FULL CCW (0.6 KILOCYCLE) POSITION

NC-1


V1 6BZ6 RF AMPLIFIER
V2 6BE6 1ST MIXER
V3 6BE6 2ND MIXER
V4 6T8 AM DETECTOR
V5 6T8 AUTOMATIC NOISE LIMITER
V6A 1/4 6T8 AM DETECTOR
V6B 1/4 6T8 AUTOMATIC NOISE LIMITER
V6C 1/4 6T8 AGC CLAMP
V7A 1/2 12AX7 PRODUCT DETECTOR
V7B 1/2 12AX7
V8 6CW8 OUTPUT AMPLIFIER
V9 5Y3GT RECTIFIER
V6D 1/4 6T8 AUDIO AMPLIFIER
SELECTIVITY SWITCH
B+135 V REG.
B+145V
B+165V
SPEAKER
PHONES


V1 6BZ6 RF AMPLIFIER
V2 6BE6 1ST MIXER
V3 6BE6 2ND MIXER
V4 6BA6 IF AMP
V5A 1/4 6T8 AM DETECTOR
V5B 1/4 6T8 AUTOMATIC NOISE LIMITER
V5C 1/4 6T8 AGC CLAMP
V6A 1/2 12AX7 PRODUCT DETECTOR
V6B 1/2 12AX7
V6D 1/4 6T8 AUDIO AMPLIFIER
V8 6CW5 OUTPUT AMPLIFIER
V9 5Y3GT RECTIFIER
SELECTIVITY SWITCH
B+105 V REG.
ALL RESISTORS 1/2 WATT ± 10% UNLESS OTHERWISE SPECIFIED
ALL CAPACITORS IN MFD ± 10% UNLESS OTHERWISE SPECIFIED

NC-190 SC



NC-190 SCHEMATIC